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Osteological Determination of Age and Sex in Mink and Otter

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Osteological Determination of Age and Sex in Mink and Otter

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Abstract

Age and sex determination of mink and otter was based on observations and measurements of the femur, baculum and skull. Results indicated a rapid increase in size during the first year with increases being more gradual and considerable overlap occurring in subsequent years. Thus the basic age separations proved to be between those greater than or less than one year of age. The baculum, however, was able to define ages up to 2.5 years. Sex determination is possible for most skeletal measurements but only after a relative age has been determined.

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INTRODUCTION

Age and sex composition of a mammal population is a very important and necessary part of any environmental study. Methods of determination must be accurate and readily applicable. Extensive osteological studies have been conducted on various mustelids by Greer (1957), Lechleitner (1954), Elder (1951), Friley (1949) and Petrides (1950) in order to determine their value as criteria for aging and sexing. The results are interesting, however, data on northern wild species, specifically mink and otter are lacking. Thus from the various documented osteological characteristics documented the following were chosen as the most promising: femur length and weight; presence or absence of a lateral supra-sesamoid tubercle; baculum weight, length and volume; zygomatic breadth; skull length and presence or absence of the jugular squamosal suture.

Femurs are of two types, differing from each other by the development of a small lateral tubercle on the distal end just proximal to the large lateral condyle and the facet of the lateral sesamoid bone. Bone in this area becomes more dense with advancing age and at the same time builds up a conical elevation known as the lateral supra-sesamoid tubercle. Lechleitner (1954) classified mink into two age classes based on the presence or absence of the tubercle. Small tubercles were considered absent and represented half year olds while medium and large tubercles were considered present and represented those a year and a half and older.

Bacula of both mink (Elder 1951) and otter (Friley 1949) serve as age criteria. Weight, length and volume tend to increase with age till maturity is reached. Transformation consists of enlargement of the head and an increase in circumferential growth of the proximal end of the body. Friley (1949) has developed an index for otter secured by taking the sum of the products of length by weight and length by volume to create four age groups: above 845, older adults; 845-650, younger adults; 649-225, immatures; below 225, very young.

Skull development is also a widely used indicator of age and sex in mammals. Suture closure, specifically the jugular squamosal suture, indicates fully grown individuals (Stephenson 1977). Two dimensions of the skull are also proven critera of age and sex: (1) condylobasal length which is the length of the skull from the posterior border of the occipital condyles to the anterior border of the premaxillae and (2) zygomatic breadth which is the greatest spread of the zygomatic arches (Birney and Fleharty 1966, Hooper and Ostenson 1949).

This study is auxiliary to a Provincial mercury study. It was designed to quantitate the relative success encountered when individual aging and sexing methods are applied to a population of winter trapped wild mink and otter that has been aged by tooth cementum layer counting. Methods of determination should be of the type that is readily observable, easily recorded and sensitive to advances in age - requirements not all met with the dental technique.

MATERIALS AND METHODS

During the 1979/80 and 1980/81 winter trapping seasons, 173 mink and 41 otter carcasses were obtained from trappers throughout Manitoba. All carcasses received had been skinned and were kept intact.

Dissection involved the removal of skull, right femur and from males the baculum. Sex was determined by observation of reproductive organs. After excess tissue was removed with a scalpel, the bones were soaked in a 1% salt solution. This served to leach out the blood and speed up the cleaning process. The salt solution was changed daily till the solution remained relatively free of blood for a 12 hour period. Generally this took 2-3 days .

Cleaning involved cooking the bones on a hot plate, in an enzyme solution. Once free of tissue the bones were removed from solution and rinsed. At this time a lower canine was extracted for aging.

Tooth aging was done by a cementum layer count method by a commercial firm specializing in this field (Matson's, Milltown, Montana). This age provided the basis upon which skeletal age was determined.

After two weeks of air drying, which allowed for shrinkage (Alexander 1960), the needed measurements were taken. Length was taken with a vernier caliper to the nearest 0.1 mm; weighing was done on a Sartorius electric balance to the nearest 0.01 g and

volume was determined in a Repipet Dispenser and Dilutor to the nearest 0.05 cc.

Measurements included: femur weight and length, zygomatic breadth (Hooper and Ostenson 1949, Wiig and Lie 1979) (Figure 1), skull length (Gould and Kreeger 1948) (Figure 1) and in males also the baculum weight, volume and length. The presence or absence of the femur tubercle (Figure 2) and jugular squamosal suture (Figure 3) was also noted.

Baculum index was derived from the following equation (length x weight) + (length x volume). The multivariate analyses of variance were run on a program available in the VS-APL system at Manitoba Data Services. T-tests were used to compare 0.5 to 1.5 year olds and where relevant 1.5 to 2.5 year olds.

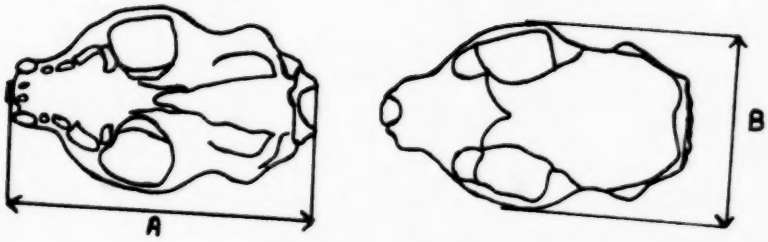

Figure 1. Otter skull showing (A) skull length and (B) *zygomatic* breadth.

Figure 2. Mink femur showing (A) tubercle absent and (B) tubercle present.

Figure 3. Mink skull with jugular squamosal suture present.

RESULTS AND DISCUSSION

MINK

Mink calculations (Tables 1 to 4) were derived from 123 mink carcasses (56 females and 67 males). Only a few samples were secured at various ages above 2.5 years so were omitted from calculations.

Males 0.5 and 1.5 year old can be separated using femur weight, femur length, zygomatic breadth and skull length based on a t-test ($p < 0.10$). The multivariate analysis of variance (Rao's approximation) on the male data produced an integrated F probability nearly 100%.

Regarding females, none of the measured parameters showed a significance ($p < 0.10$) when a t-test was performed. A multivariate analysis of variance (Rao's approximation) did, however, produce an integrated F probability of 90% indicating that by grouping, the parameters will contribute somewhat towards aging. The importance of the femur weight and length is unclear as in females Lechleitner (1954) also found no significance while male data indicates a significant difference between 0.5 and 1.5 year olds ($p < 0.05$). Values of ≤ 1.40 g and ≤ 53 mm represent 0.5 year olds with regard to femur weight and length, respectively.

Zygomatic breadth and skull length present the same situation as the femur as both show significance only in comparison of 0.5 and 1.5 year old males and no significance for females. The male findings are supported by Birney and Fleharty

(1966) who state that these parameters have the ability to distinguish between juveniles and adults. Lechleitner (1954) also found the zygomatic breadth a reliable indicator, but not the skull length.

Calculations on the femur tubercle and jugular squamosal suture (Table 2) indicate that the suture is a somewhat more accurate indicator of age but, in both cases, the 1.5 and older age groups were correctly classified more frequently than the 0.5 year olds and males were classified more frequently than females. This agrees with the findings of Greer (1957).

It should be noted that although Lechleitner (1954) found the femur tubercle to be a fairly reliable indicator of age, he found no use for the jugular squamosal suture.

All baculum measurements can be used to separate two age classes and baculum weight and index can also be used to define the first three age classes ($p < 0.10$) (Table 1). Age class representations are presented in Table 3. As the baculum of mink develops to full size only after the animal has reached sexual maturity, which occurs at 18 months of age (Elder 1951) it should prove valuable as an aging device. The first two age classes can be separated by baculum length. Its inability to define further age classes may be a result of the many variations in the curvature of the bone as is found in marten (Marshall 1951).

Baculum weight, unlike length, does not reach its maximum at sexual maturity but seems to increase considerably in succeeding years (Elder 1951). This explains the ability of baculum weight to

significantly separate three age classes. The ranges correspond to Birney and Fleharty (1968). Lechleitner (1954) once again disagrees with these findings by stating that baculum weight cannot be used to separate age groups.

The ability of baculum volume to separate 1.5 and 2.5 year olds is explained by Friley (1949) who states that in mustelids great increases in circumferential growth take place in the young adult stage after most of the length is achieved, thus causing significant increases in volume.

Baculum index values have not been previously calculated for mink so the values found in this study cannot be compared to values in other populations. Its importance as an aging criterion, though, has been demonstrated.

Comparisons between the sexes (Table 4) indicate that in all instances there is a significant difference ($p < 0.01$). Birney and Fleharty (1966) have indicated that zygomatic breadth, skull length and weight, and length of the humerus can be used to distinguish between the sexes. Since all leg bones grow proportionately it is not surprising that the femur can also be used to separate the sexes.

Small sample sizes of the older age classes makes a complete analysis impossible but there are indications that age class differences do exist and can be measured. This is especially true in the case of the baculum. Based on the fact that individuals less than one year of age represent the largest age class in a regularly harvested population and can be separated out by

osteological means, further investigations are unnecessary at this time.

OTTER

Tables 3 to 6 represent the values calculated from 22 otter samples comprised of 10 females and 12 males. As with mink, age classes above 2.5 years were poorly represented and thus omitted from calculations.

Regarding females, two parameters differ significantly ($p < 0.10$) when a t-test is performed. Femur weight with ranges; 4.0 to 5.1 g and 5.2 to 8.5 g and zygomatic breadth with ranges; 61.4 to 69.0 mm and 69.1 to 75.4 mm, represent 0.5 and 1.5 year olds respectively. In males femur length is significant ($p < 0.10$) in separating 0.5 and 1.5 year olds based on ranges of 67.0 to 74.5 mm and 74.6 to 83.0 mm respectively.

The exact importance of the femur is unclear at this time because of the small sample sizes but, there is enough evidence to justify further study.

Stephenson (1977) as well as Hooper and Ostenson (1949) have found the zygomatic breadth to be a good indicator for the first two age classes for both sexes as it exhibits a continuous increase with age. The small sample size may be the reason for the absence of support in males.

Presence or absence of the femur tubercle and jugular squamosal suture, (Stephenson 1977) prove invaluable in separating the two age classes for both males and females (Table 6).

All baculum measurements show differentiation between 0.5, 1.5 and 2.5 years olds ($p < 0.05$) (Table 5). Age class representations are presented in Table 3. Baculum length increases to a maximum in three years (Stephenson 1977) but growth is most rapid in the first year (Friley 1949) thus making it an important aging tool for the most common age classes harvested. Baculum weight reaches its maximum in 6 years (Stephenson 1977) which also makes it important in aging. Volume of the baculum also increases with age especially after most of the length has been attained. This is basically a result of the increase in circumferential growth (Friley 1949)

The baculum measurements were combined into an index as formulated by Friley (1949), and then correlated to an actual age as found by tooth aging to creating specific age ranges (Table 3). These ranges may have been found to represent actual male age classes of up to several years had larger sample sizes been available.

Comparisons between the sexes (Table 4) indicates that only femur weight and femur length in the case of 0.5 year olds is significant ($p<0.10$). Literature, however, states that there also exists a clear sexual dimorphism in skull dimensions (Stephenson 1977, Bree et al. 1966 and Hooper and Ostenson 1949). This indicates that larger sample sizes are needed before a complete analysis of sexual differences is possible.

It must be kept in mind that the otter age classes are best estimates derived from a small sample size and as such should not be taken as exact for all otter populations. They do, however, show that age classes can be determined and provide working ranges for these classes. This is especially true for the separation of those individuals less than one year of age which comprise the largest age class represented in a regularly harvested population.

CONCLUSION

In general, the measurements indicate a rapid increase in size during the first year. Subsequent annual increases are more gradual producing considerable overlap in measurements with progressing years.

Using the femur tubercle, jugular squamosal suture and especially the baculum, along with the parameters listed in Table 3, one is able to separate out these individuals less than one year of age. This would comprise the major separation needed for a sampled population. For those few females older than 1 year and males older than 2.5 years reliance on cementum annuli would provide accurate ages at relatively little expense.

Aging by osteological means is valuable for the majority of age determinations but requires further study with regards to older ages due to the discrepancies found between the sexes and within the literature.

Sex determination is possible from most skeletal measurements but only after a relative age has been determined.

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TABLE 1: Mink Measurements; Mean, Two Standard Errors, Range and Level of Significance[1]

Parameter	Sex	Age Class	n	Mean ±2(S.E.)	Range	Level of Sign [1,2]
Femur Weight (g)	F	0.5	48	0.83 ± 0.07	0.57 - 1.71	
		1.5	8	0.95 ± 0.06	0.80 - 1.10	
	M	0.5	48	1.35 ± 0.07	0.86 - 1.95	0.05
		1.5	10	1.57 ± 0.16	1.17 - 1.98	
		2.5	9	1.52 ± 0.13	1.30 - 1.80	
Femur Length (mm)	F	0.5	48	45.2 ± 1.2	39.9 - 67.0	
		1.5	8	46.0 ± 0.8	44.8 - 48.0	
	M	0.5	48	51.5 ± 0.7	47.0 - 56.0	0.05
		1.5	10	54.0 ± 3.7	49.5 - 69.5	
		2.5	9	51.1 ± 1.3	48.0 - 55.5	
Zygomatic Breadth (mm)	F	0.5	48	35.0 ± 0.6	32.0 - 42.0	
		1.5	8	35.9 ± 0.6	34.4 - 37.5	
	M	0.5	48	39.2 ± 0.6	33.0 - 43.3	0.05
		1.5	10	40.9 ± 1.2	38.0 - 43.2	
		2.5	9	41.0 ± 1.0	38.6 - 43.0	
Skull Length (mm)	F	0.5	48	62.0 ± 0.9	57.2 - 72.3	
		1.5	8	62.8 ± 0.7	61.1 - 64.0	
	M	0.5	48	68.0 ± 0.9	57.0 - 74.0	0.10
		1.5	10	69.9 ± 1.5	66.4 - 74.0	
		2.5	9	68.9 ± 0.8	66.6 - 70.0	
Baculum Weight (g)	M	0.5	48	0.17 ± 0.01	0.12 - 0.36	0.05
		1.5	10	0.31 ± 0.07	0.13 - 0.45	
		2.5	9	0.41 ± 0.02	0.37 - 0.47	0.05
Baculum Length (mm)	M	0.5	48	41.5 ± 0.8	34.0 - 46.0	0.05
		1.5	10	44.5 ± 2.0	39.0 - 49.2	
		2.5	9	45.5 ± 1.0	43.5 - 47.9	
Baculum Volume (cc)	M	0.5	48	0.09 ± 0.01	0.02 - 0.20	
		1.5	10	0.10 ± 0.03	0.05 - 0.15	
		2.5	9	0.14 ± 0.03	0.10 - 0.20	0.05
Baculum Index	M	0.5	48	10.99 ± 1.09	6.41 - 23.32	0.01
		1.5	10	18.53 ± 4.65	7.24 - 28.80	
		2.5	9	25.39 ± 1.92	21.23 - 29.70	0.05

1 Level of significance when a t-test performed.
2 Blank space indicates a level of significance below 10%.

TABLE 2: Presence or Absence of the Femur Tubercle and Jugular Squamosal Suture in Mink.

Femur Tubercle

Male			Female		
Age class	n	% Correct[1]	Age class	n	% Correct[1]
0.5	48	41.7	0.5	48	45.8
1.5	10	90.0	1.5	8	75.0
2.5	9	100.0			

Jugular Squamosal Suture

Male			Female		
Age class	n	% Correct[1]	Age class	n	% Correct[1]
0.5	48	56.3	0.5	48	39.6
1.5	10	90.0	1.5	8	100.0
2.5	9	100.0			

1 Precentage of the correct findings are those mink less than one year of age which have the femur tubercle absent and the suture present and those mink greater than one year of age which have the femur tubercle present and the suture absent.

TABLE 3.: Age Class Representations for Mink and Otter[1].

Mink - Female[2]	Age Class 0.5	1.5	2.5

Mink - Male	AGE CLASS 0.5	1.5	2.5
Femur Weight (g)	≤1.40	> 1.40	
Femur Length (mm)	≤53.0	>53.0	
Zygomatic Breadth (mm)	≤39.7	>39.7	
Skull Length (mm)	≤68.7	>68.7	
Baculum Weight (g)	<0.22	0.22-0.38	0.39-0.43
Baculum Length (mm)	≤42.5	>42.5	
Baculum Volume (cc)			>1.3
Baculum Index	<47	47-77	78-98

Otter - Female	0.5	1.5	2.5
Femur Weight (g)	4.0- 5.1	5.2- 8.5	
Zygomatic Breadth (mm)	61.4-69.0	69.1-75.4	

Otter - Male	0.5	1.5	2.5
Femur Length (mm)	67.0-74.5	74.6 -83.0	
Baculum Weight (g)	<2.71	2.71- 4.61	4.62-5.90
Baculum Length (mm)	<84.0	84.0 -94.0	94.1-100.5
Baculum Volume (cc)	<2.3	2.3 - 3.3	3.4-4.0
Baculum Index	<348	348-740	741-975

1 Parameters found significant ($p<0.10$).
2 No significant differences were noted for female mink.

TABLE 4: Comparisons between the Sexes for Mink and Otter.

Parameters	Age Class	Mink Level of Sign.[1,2]	Otter Level of Sign.[1]
Femur Weight	0.5	0.01	0.01
	1.5	0.01	-
Femur Length	0.5	0.01	0.10
	1.5	0.01	-
Zygomatic Breadth	0.5	0.01	-
	1.5	0.01	-
Skull length	0.5	0.01	-
	1.5	0.01	-

1 t-test performed
2 Blank indicates ($p < 0.10$)

TABLE 5: Otter Measurements; Mean, Two Standard Errors, Range and Level of Significance[1]

Parameter	Sex	Age Class	n	Mean +2 (S.E.)	Range	Level of Sign.[1,2]
Femur Weight (g)	F	0.5	5	4.66 ± 0.54	4.18 - 5.70	0.10
		1.5	5	6.71 ± 1.73	4.17 - 9.58	
	M	0.5	8	6.58 ± 0.79	5.39 - 8.54	
		1.5	2	8.05 ± 2.61	6.75 - 9.35	
		2.5	2	7.55 ± 0.40	7.35 - 7.75	
Femur Length (mm)	F	0.5	5	67.5 ± 5.3	58.1 - 74.1	
		1.5	5	72.9 ± 5.2	65.0 - 79.0	
	M	0.5	8	72.7 ± 2.7	69.3 - 80.0	0.10
		1.5	2	78.6 ± 4.4	76.4 - 80.8	
		2.5	2	75.6 ± 0.1	75.5 - 75.6	
Zygomatic Breadth (mm)	F	0.5	5	65.7 ± 3.0	61.4 - 69.0	0.05
		1.5	5	71.8 ± 2.2	69.4 - 75.4	
	M	0.5	8	69.1 ± 3.6	64.0 - 77.0	
		1.5	2	70.3 ± 2.5	69.0 - 71.5	
		2.5	2	72.4 ± 4.0	70.4 - 74.4	
Skull Length (mm)	F	0.5	5	105.4 ± 4.2	102.0 - 111.2	
		1.5	5	106.5 ± 3.7	102.5 - 113.0	
	M	0.5	8	108.9 ± 3.1	103.9 - 115.0	
		1.5	2	108.1 ± 7.3	104.4 - 111.7	
		2.5	2	107.3 ± 0.4	107.1 - 107.5	
Baculum Weight (g)	M	0.5	8	1.90 ± 0.27	1.28 - 2.52	0.05
		1.5	2	3.22 ± 0.65	2.89 - 3.54	
		2.5	2	5.79 ± 0.23	5.67 - 5.90	0.05
Baculum Length (mm)	M	0.5	8	75.2 ± 2.5	68.0 - 79.6	0.05
		1.5	2	88.9 ± 1.0	88.4 - 89.4	
		2.5	2	99.5 ± 2.0	98.5 - 100.5	0.05
Baculum Volume (cc)	M	0.5	8	1.5 ± 0.3	1.0 - 2.2	0.05
		1.5	2	2.4 ± 0.2	2.3 - 2.5	
		2.5	2	4.0 ± 0.0	4.0 - 4.0	0.05
Baculum Index	M	0.5	8	257 ± 46.88	155 - 348	0.05
		1.5	2	499 ± 34.07	482 - 516	
		2.5	2	974 ± 3.01	972 - 975	0.05

1 Level of significance when a t-test is performed.
2 Blank spaces indicates a level of significance below 10%.

TABLE 6: Presence or Absence of the Femur Tubercle and Jugular Squamosal Suture in Individual Otter Samples.

Age Class	Male Femur[2]	Suture[2]	Age Class	Female Femur[2]	Suture[2]
0.5	0	1	0.5	0	1
0.5	0	1	0.5	0	1
0.5	0	1	0.5	0	1
0.5	0	1	0.5	0	1
0.5	0	1	0.5	0	1
0.5	0	1	1.5	1	0
0.5	0	1	1.5	1	0
0.5	0	1	1.5	1	0
1.5	1	0	1.5	1	0
1.5	1	0	1.5	1	0
2.5	1	0			
2.5	1	0			

2 0 = Absent, 1 = Present.

POOR

QUALITY

ORIGINAL